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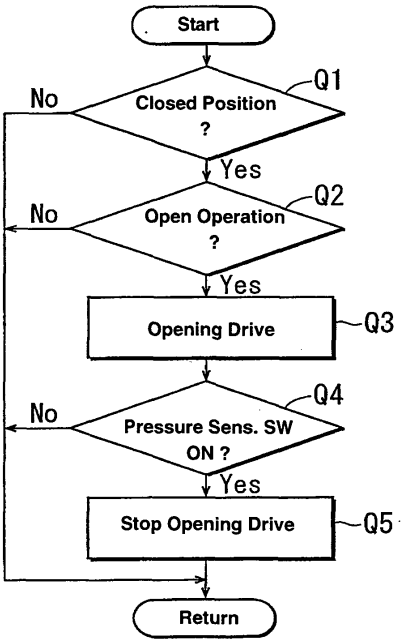
(54) Pinch prevention of slide device

(57) A slide door **20** is provided to be movable between a closed position to cover a side opening **10** formed at a vehicle-body side face and an open position. The slide door **20** is configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from the closed position to the open position. There is provided a detection sensor **50** to detect a foreign matter in coming into a gap **S** from a vehicle-compartment inside. A drive of the slide door **20** is stopped in case the detection sensor **50** detects the foreign matter in coming into the gap **S** when the slide door **20** moves toward the open position. Thereby, any foreign matter can be prevented from being pinched in the gap formed between the slide door and the rear edge portion of the side opening.

FIG. 12



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Description

[0001] The present invention relates to a pinch prevention of a slide door.

[0002] A vehicle, such as a so-called one-box type of automotive vehicle, is equipped with a slide door that is provided to open and close a side opening formed at a vehicle-body side face, through which a passenger gets onto or gets off from a rear seat. The slide door is generally configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from its closed position to its open position. The slide door may be driven by an electric motor.

[0003] Herein, when the slide door is moved from the closed position to the open position, a gap is formed between an inner side face of the slide door and a rear edge portion of the side opening. Japanese Patent Laid-Open Publication No. 2007-56522 discloses a pressure sensitive sensor that is provided at the inner side face of the slide door to detect a load that occurs in a vehicle width direction thereof when any foreign matter is pinched in this gap. This publication also discloses an electrically-driven slide-door control, in which when this foreign-matter pinch is detected, the drive of the slide door is stopped or its drive direction is reversed. Meanwhile, Japanese Patent Laid-Open Publication No. 11-182136 discloses another pinch detection by a pressure sensitive sensor that is provided at a front edge portion of the slide door to detect any foreign matter when the slide door moves from the open position to the closed position (detection of pinch between the slide door and the front edge portion of the side opening).

[0004] The above-described publications just disclose the foreign-matter pinch detection itself, but not disclose any effective measures to prevent the foreign-matter pinch properly.

[0005] The present invention has been devised in view of the above-described problem, and an object of the present invention is to provide a pinch prevention structure, method of a slide door and a cover member that can prevent any foreign matter from being pinched in the gap formed between the slide door and the rear edge portion of the side opening when the slide door is moved from the closed position toward the open position.

[0006] This object is solved according to the present invention by the features of the independent claims. Preferred embodiments of the present invention are subject of the dependent claims.

[0007] According to the present invention, there is provided a pinch prevention structure of a slide door, comprising a slide door provided to be movable between a closed position in which the slide door at least partly covers a side opening formed at a vehicle-body side face and an open position in which the slide door substantially opens the side opening, the slide door being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from the closed position to the open position, a drive device operative to drive the slide door so as to move between the closed position and the open position, a drive control device operative to control the drive device, and a detection sensor operative to detect a foreign matter in coming into a gap from a vehicle-compartment inside, which is formed between an inner side face of the slide door and a rear edge portion of the side opening when the slide door is moved from the closed position toward the open position, wherein the drive control device is configured so that a drive of the slide door by the drive device is stopped in case the detection sensor detects the foreign matter in coming into the gap when the drive device drives the slide door in the closed position toward the open position. According to the present invention, when the foreign matter is about to come into the gap from the vehicle inside, the detection sensor detects such foreign matter and thereby the drive of the slide door toward the open position is stopped. Thereby, any foreign matter can be prevented from being pinched in the gap properly.

[0008] According to an embodiment of the present invention, the rear edge portion of the side opening includes a rear-edge front face portion that faces substantially forward and a rear-edge side face portion that extends substantially forward from an inside end of the rear-edge front face portion, the rear-edge front face portion and the rear-edge side face portion forming an open edge portion that is recessed toward the vehicle inside, at the open edge portion is provided a cover member that is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover part of the gap formed when the slide door is moved from the closed position toward the open position, and the detection sensor is configured to detect the foreign matter in contacting the cover member in an operative position from the front. Thereby, since the cover member is located at the operative position so as to at least partly cover part of the gap when the slide door is moved from the closed position toward the open position, it can be surely prevented that any object (foreign matter) located inside the vehicle from coming into the gap. Further, the cover member itself can be utilized as means for detecting any foreign matter. Also, since the cover member is disposed by properly using a space of the recessed open edge portion that is recessed, there may be no need to provide any particular layout space for the cover member.

[0009] According to another embodiment of the present invention, the cover member is comprised of a plate member that extends substantially vertically and configured to operate so as to at least partly cover the part of the gap in connection with the slide door moving from the closed position to the open position. Herein, the plate member may be preferable in providing a simple and small-sized cover member. Further, since the cover member operates cover the part of the gap in connection with the slide door moving from the closed position to the open position, the gap can be at least partly covered by

the cover member surely.

[0010] According to another embodiment of the present invention, the cover member is provided so as to rotate around a vertically-extending axis between the operative position in which the cover member extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position in which the cover member extends substantially in a vehicle longitudinal direction, a biasing means for biasing the cover member toward the operative position is provided, and the detection sensor is configured to detect the foreign matter in response to a rearward move of an outside end portion of the cover member in the operative position receives an outer force from the front that is greater than a biasing force of the biasing means. Herein, the cover member can be automatically changed in position between the operative position and the store position in connection with the slide door moving with a simple structure using the rotation and the biasing means. Further, a situation in which any foreign matter comes into the gap can be detected surely by properly using the rearward move of the outside end portion of the cover member in the operative position.

[0011] According to another embodiment of the present invention, the cover member, which is comprised of a plate member that extends substantially vertically, is supported by a vehicle body at an inside end portion thereof that is held rotatably around a substantially vertically-extending axis so that the cover member moves between the operative position and a store position in which the cover member extends substantially in a vehicle longitudinal direction along the rear-edge side face portion of the open edge portion, a biasing means for biasing the cover member toward the operative position is provided, and the cover member is configured such that the cover member is rotated toward the operative position by the biasing means when the slide door is moved toward the open position from the closed position, while the cover member is coupled to, preferably pushed by, the slide door so as to come to the store position when the slide door is moved toward the closed position from the open position. Herein, the plate member may be preferable in providing a simple and small-sized cover member. The cover member can be automatically changed in position between the operative position and the store position in connection with the slide door moving with the simple structure using the rotation and the biasing means.

[0012] According to another embodiment of the present invention, the cover member is configured such that an outside end portion thereof in the operative position has a contour that corresponds to a contour of the inner side face of the slide door. Herein, the gap can be preferably covered in a properly wide range in the vehicle width direction, preventing interference of the slide door moving toward the open position with the cover member in the operative position.

[0013] According to another embodiment of the present invention, an armrest is formed at the inner side face of the slide door so as to project, and the cover member is configured to cover the gap at least at a level of or near an upper face of the armrest. Herein, a situation in which an object (foreign matter) placed on the armrest would come into the gap can be prevented surely.

[0014] According to another embodiment of the present invention, an armrest is formed at the inner side face of the slide door so as to project, and an outside end portion of the cover member in the operative position has a notch with a contour that corresponds to a contour of the armrest. Herein, any interference of the armrest with the cover member can be prevented, allowing the passenger to use the armrest at the slide door in the closed position. Further, while the gap may become considerably wide in the vehicle width direction because the slide door with the armrest needs to move outward enough to avoid interference of the armrest with the vehicle body for its closing, the cover member can cover the wide gap properly and thereby the pinch can be prevented surely.

[0015] According to the invention, there is further provided a cover member for a pinch preventing structure, in particular according to the invention or a preferred embodiment thereof, of a slide door provided to be movable between a closed position in which the slide door at least partly covers a side opening formed at a vehicle-body side face and an open position in which the slide door substantially opens the side opening, the slide door being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from the closed position to the open position, wherein the cover member is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover at least part of a gap formed when the slide door is moved from the closed position toward the open position.

[0016] According to a preferred embodiment, said cover member is comprised of a plate member that extends substantially vertically and configured to operate so as to at least partly cover the part of the gap in connection with the slide door moving from the closed position to the open position.

[0017] According to a further preferred embodiment, said cover member is provided so as to rotate around a vertically-extending axis between the operative position in which the cover member extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position in which the cover member extends substantially in a vehicle longitudinal direction, a biasing means for biasing the cover member toward the operative position is provided, and a detection sensor is configured to detect the foreign matter in response to a rearward move of an outside end portion of the cover member in the operative position receives an outer force from the front that is greater than a biasing force of the

biasing means.

[0018] According to a further preferred embodiment, said cover member, which is comprised of a plate member that extends substantially vertically, is to be supported by a vehicle body at an inside end portion thereof that is holdable rotatably around a substantially vertically-extending axis so that the cover member moves between the operative position and a store position in which the cover member extends substantially in a vehicle longitudinal direction along the rear-edge side face portion of the open edge portion, a biasing means for biasing the cover member toward the operative position is provided, and the cover member is configured such that the cover member is rotated toward the operative position by the biasing means when the slide door is moved toward the open position from the closed position, while the cover member is coupled to, preferably is pushed by, the slide door so as to come to the store position when the slide door is moved toward the closed position from the open position.

[0019] According to the invention, there is further provided a pinch prevention method, in particular for use with a pinch prevention structure according to the invention or a preferred embodiment thereof, for a slide door movable between a closed position in which the slide door at least partly covers a side opening formed at a vehicle-body side face and an open position in which the slide door substantially opens the side opening, the slide door being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from the closed position to the open position, the method comprising the following steps

driving the slide door so as to move between the closed position and the open position;

detecting a foreign matter in coming into a gap from a vehicle-compartment inside, which is formed between an inner side face of the slide door in the open position and a rear edge portion of the side opening when the slide door is moved from the closed position to the open position,

wherein a drive of the slide door is stopped in case the foreign matter is detected in coming into the gap when the slide door is driven in the closed position toward the open position.

[0020] According to a preferred embodiment, in the step of detecting it is detected whether the foreign matter contacts substantially from the front a cover member that is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover at least part of a gap formed when the slide door is moved from the closed position toward the open position, the cover member.

[0021] According to a further preferred embodiment, said cover member is provided so as to rotate around a vertically-extending axis between the operative position in which the cover member extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position in which the cover member extends substantially in a vehicle longitudinal direction, a biasing means for biasing the cover member toward the operative position is provided, and in said detecting step of the foreign matter is detected in response to a rearward move of an outside end portion of the cover member in the operative position receives an outer force from the front that is greater than a biasing force of the biasing means, and/or

wherein said cover member, which is comprised of a plate member that extends substantially vertically, is supported by a vehicle body at an inside end portion thereof that is held rotatably around a substantially vertically-extending axis so that the cover member moves between the operative position and a store position in which the cover member extends substantially in a vehicle longitudinal direction along the rear-edge side face portion of the open edge portion, a biasing means for biasing the cover member toward the operative position is provided, and the cover member is configured such that the cover member is rotated toward the operative position by the biasing means when the slide door is moved toward the open position from the closed position, while the cover member is coupled to, preferably is pushed by, the slide door so as to come to the store position when the slide door is moved toward the closed position from the open position.

[0022] Other features, aspects, and advantages of the present invention will become apparent from the following description which refers to the accompanying drawings.

FIG. **1** is a brief plan view showing a slide door in a closed position and a cover member in a store position according to a first embodiment of the present invention.

FIG. **2** is a brief plan view showing a state in which the slide door is moved toward an open position from a state shown in FIG. **1.**

FIG. **3** is a perspective view showing a side opening and the cover member.

FIG. **4** is a view, when viewed from the front, showing a state in which the cover member covers a gap that is formed when the slide door is opened, when viewed from the front.

FIG. **5** is a perspective view showing the cover member in a store position at a state in which the slide door is in the closed position.

FIG. **6** is a perspective view showing the cover member in an operative position when the slide door is opened from state shown in FIG. **5.**

FIG. **7** is an exploded perspective view of an exemplified major portion for attaching the cover member to a vehicle body.

FIG. **8** is a perspective view of a holding bracket shown in FIG. **7.**

FIG. **9** is a sectional view of the major portion show-

ing an attachment relation between the cover member and the holding bracket.

FIG. **10** is a brief plan view of an exemplified portion for driving the slide door.

FIG. **11** is a block diagram showing an exemplified control system of the present invention.

FIG. **12** is a flowchart showing an exemplified control of the present invention.

FIG. **13** is a perspective showing a second embodiment of the present invention, which corresponds to FIG. **7.**

FIG. **14** is a sectional view of an exemplified major portion for attaching a pressure sensitive switch to the vehicle body according to the second embodiment of the present invention shown in FIG. **13.**

FIG. **15** is a perspective view showing a third embodiment of the present invention, which corresponds to FIG. **7.**

FIG. **16** is a perspective view of a holding bracket shown in FIG. **15.**

FIG. **17** is a sectional view of the major portion showing an attachment relation between the cover member and the holding bracket.

[0023] Hereinafter, preferred embodiments of the present invention will be described referring to the accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

EMBODIMENT 1

[0024] In FIGS. **1** through **4,** reference character **1** denotes a vehicle body, **2** denotes a B pillar (center pillar), **3** denotes a C pillar that is located backward of or right behind the B pillar **2,** and **4** denotes a rearmost D pillar that is located behind the C pillar **3.**

[0025] As apparent from FIG. **3,** a side opening **10** is formed at a vehicle-body side face particularly between the B pillar **2** and the C pillar **3.** A front edge portion of the side opening **10,** which is provided for ingress and egress of a passenger for a rear seat (second-row seat) **11,** is comprised of the B pillar **2,** its rear edge portion is comprised of the C pillar **3,** its lower edge portion is comprised of at least a portion of a side sill **12,** and its upper edge portion is comprised at least of a potion of a roof side rail (outer end portion of a roof panel) **13.**

[0026] The side opening **10** is at least partly opened and closed by a slide door **20.** That is, the slide door **20** is configured to take a closed position CP in which the side opening **10** is closed by it (a state shown in FIG. **1**) and an open position OPP in which the side opening **10** is opened by it. More specifically, the slide door 20 is configured to substantially move outward and subsequently slide rearward along a rear fender **14** when the slide door **20** moves from the closed position CP shown in FIG. **1** to the open position OPP in which the side opening **10** is almost fully opened (a move shown by an arrow in FIG. **1**). FIG. **2** shows a state in which the slide door **20** substantially moves outward and subsequently slides rearward slightly toward the open position OPP. A return of the slide door **20** from the open position OPP to closed position CP follows a move that preferably substantially is reverse to the opening move of the slide door **20.** The slide door **20** preferably is comprised of an electrically-driven type of door that is opened and/or closed by a motor (or the opening and/or closing is assisted by the motor), which will be described below.

[0027] The C pillar **3** forming at least part of the rear edge portion of the side opening **10** includes a rear-edge front face portion **3a** and a rear-edge side face portion **3b** that extends substantially forward from an inside end of the rear-edge front face portion **3a.** An outside end of the rear-edge front face portion **3a** is to be connected to a front end of the rear fender **14.** Thus, the rear-edge front face portion **3a** and the rear-edge side face portion **3b** form an open edge portion **15** that preferably is slightly recessed toward the vehicle inside from the rear fender **14** forming the vehicle-body outer face. An open edge portion that corresponds to the open portion edge is also formed at the B pillar **2,** side sill **12** and roof side rail **13.**

[0028] The slide door **20** in the closed position CP is at least partly stored in the open edge portion **15** so that an outer face of the slide door **20** preferably can be substantially flush with the rear fender **14.** In other words, a degree (a vehicle-width-direction size) of the recess forming of the open edge portion **15** (rear-edge front face portion **3a)** toward the vehicle inside preferably is set substantially in accordance with a thickness of the slide door **20.** And, the longitudinal size of the rear-edge side face portion **3b** preferably is set so as to provide a proper water proof (sealing).

[0029] At an inner face of the slide door **20** are formed an armrest **21** and/or a storage box **22** (e.g. for bottles or the like) that preferably is adjacent to, particularly located before the armrest **21.** As shown in FIG. **4,** the armrest **21** preferably is provided so that its upper face is positioned at a slightly higher level than a seat face of a seat cushion **11A** of the rear seat **11** (at a middle position of a seat back **11B).** The storage box **22** preferably is provided so that its upper face is positioned substantially at the same level as the seat face of the seat cushion **11A**. However, respective positions of these members **21, 22** may be set at any level instead.

[0030] At the open edge portion **15** is provided at least one cover member **30.** The cover member **30** is made e.g. of synthetic resin or light metal, for example, so as to have rigidity as a whole, and comprised of a plate member that extends substantially vertically according to the present embodiment. The cover member **30** can take an operative position OP in which it extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction as shown by solid lines in FIGS. **2** and **3,** and a store position SP in which it extends substantially

in the vehicle longitudinal direction as shown by one-dotted broken lines in FIGS. **1** and **3.** Thus, the cover member **30** in the operative position OP is positioned preferably so as to extend substantially along the rear-edge front face portion **3a.** Meanwhile, the cover member **30** in the store position SP is positioned preferably so as to extend substantially along the rear-edge side face portion **3b.**

[0031] The cover member **30** in the operative position OP is (directly or indirectly) supported by the vehicle body (C pillar **3)** at its inside end portion that is held rotatably or pivotably around a (preferably substantially vertically-extending) axis. The cover member **30** is biased toward the operative position OP as described below. Thereby, the cover member **30** can be automatically rotated or pivoted toward the operative position OP in connection with the slide door **20** moving from the closed position CP to the open position OPP. When the slide door **20** moves from the open position OPP to the closed position CP, the cover member **30** is pushed or urged or displaced toward the store position SP by the slide door **20.**

[0032] FIG. **5** shows the cover member **30** in the store position SP, in which its sectional structure near the C pillar **3** at a level of the upper face of the armrest **21** is shown briefly by a one-dotted broken line. FIG. **6** shows the cover member **30** in the operative position OP, in which its sectional structure near the C pillar **3** at the level of the upper face of the armrest **21** is shown briefly by a one-dotted broken line.

[0033] A gap **S** is formed between the inner side face of the slide door **20** and the C pillar **3** (its outer side end) when the slide door **20** is moved from the closed position CP to the open position OPP (see FIGS. **2, 4** and **6).** The gap **S** is at least partly covered substantially from the front by the cover member **30** that is moved automatically towards or to the operative position OP in connection with the forming of the gap **S** (the moving of the slide door **20** from the closed position CP to the open position OPP). The cover member **30** is provided so that it can at least partly cover the gap **S** preferably in a range that substantially corresponds to a level of the passenger seated in the rear seat **11.** That is, the cover member **30** preferably covers the gap **S** substantially in the range from the level of the seat face of the seat cushion **11A** to a level that is slightly below an upper end of the seat back **11B** in its upright position. More specifically, a situation in which any object, as a foreign matter, is placed on the armrest **21** may happen frequently. Herein, it may become likely that such any object on the armrest **21** comes or at least partly enters into the gap **S** inadvertently when the slide door **20** is opened. Accordingly, the cover member **30** that preferably covers the level range around the upper face of the armrest **21** (e.g. about 20 cm upward and about 20 cm downward with respect to the upper face level of the armrest **21**) can properly prevent such any object from coming into the gap **S.**

[0034] In particular, as apparent from FIG. **4,** the cover member **30** is configured such that an outside end portion of the cover member **30** in the operative position OP preferably has a contour that substantially corresponds to a contour of the inner side face of the slide door **20.** Specifically, the outside end portion of the cover member **30** in the operative position OP has a notch **30a** with a contour that substantially corresponds to a contour of the armrest **21.** Thereby, the gap **S** can be preferably covered by the cover member **30** in a properly wide (long) range in the vehicle width direction, preventing interference of the slide door **20** moving from the closed portion CP toward the open position OPP.

[0035] FIGS. **7** through **9** show an example of concrete attachment of the cover member **30** to the vehicle body. At the inside end portion of the cover member **30** in the operative position OP is held a (preferably substantially vertically-extending) support axis **35.** The support axis **35** is rotatably or pivotably supported by one or more, preferably a pair of holding brackets **40** (preferably at or near its upper and/or lower end portions). Since the both brackets preferably have the substantially same structure, an attachment relation between the cover member **30** and the upper holding bracket **40** will be described.

[0036] The holding bracket **40** is fixed to the vehicle body (the open edge portion **15)** with a fixing tool **41** such as a bolt. The above-described support axis **35** is at least partly inserted into a holding hole **42** that is formed at the holding bracket **40,** and prevented from getting out e.g. by a screw **44.** At a lower face of the holding bracket **40** is formed a recess **40a,** where a coil spring **43** as a preferred biasing means is at least partly disposed. The coil spring **43** preferably is provided so as to surround the support axis **35.** One end of the coil spring **43** engages with the holding bracket **40,** and the other end engages with the cover member **30.** The cover member **30** is biased toward the operative position by the biasing means (preferably the coil spring **43).**

[0037] There is provided a pressure sensitive switch **50** as a detection sensor shown in FIG. **7,** for example, to detect that a rearward outer force that is a specified (predetermined or predeterminable) value or greater acts on the cover member **30** in the operative position. The pressure sensitive switch **50,** for example, comprises a casing **51** that is fixed to the rear-edge front face portion **3a,** a contact **52** that is movable longitudinally relative to the casing **51,** a spring **53** that is disposed in the casing **51** and biases the contact **52** forward, and/or a switch (not illustrated) that is disposed in the casing **51** and turns on when the contact **52** is moved rearward by a specified (predetermined or predeterminable) distance. The contact **52** preferably is located right behind the cover member **30** in the operative position.

[0038] Herein, a biasing force of the spring **53** of the pressure sensitive sensor **50** preferably is set to be greater than the one of the coil spring **43.** Accordingly, when the rearward outer force that is the specified (predetermined or predeterminable) value or greater acts on the cover member **30** in the operative position, the pressure sensitive switch **50** turns on, so it is detected that the

great rearward outer force acts on the cover member **30.** And, as described below, when the pressure sensitive switch **50** turns on, the move of the slide door **20** toward the open position is forced to stop. Herein, the cover member **30** in the operative position is made contact the contact **52** of the pressure sensitive switch **50** by the biasing force of the coil spring **43.** In this state, when the rearward outer force that is the specified (predetermined or predeterminable) value or greater acts on the cover member **30** rearward, the cover member **30** is rotated or pivoted slightly pushing the contact **52** rearward, but its further rearward rotation or pivotal movement is prevented by the pressure sensitive switch **50** (the rear-edge front face portion **3a** to which the pressure sensitive switch **50** is attached). Thus, the cover member **30** has a function as the foreign-matter detection to operate the pressure sensitive switch **50** and/or a function of preventing any foreign matter from coming into the gap **S.**

[0039] FIG. **10** shows an exemplified portion for driving the electrically-driven slide door **20.** In this figure reference character **60** denotes at least one guide rail, which is to be fixed to the vehicle body so as to extend from the open edge portion **15** substantially along the rear fender **14.** One or more slide members or rollers **62,** such as a pulley, which are held at a bracket **61** that preferably is rotatably supported at a rear end portion of the slide door **20,** are at least partly disposed in the guide rail **60** so as to move smoothly inside the guide rail **60.**

[0040] A guide wire **63** is connected to the above-described bracket **61.** The guide wire **63** is disposed with a guide pulley **64** so as to extend along the guide rail **60.** The guide wire **63** is made to reciprocate by a drive mechanism **65,** which comprises a motor **65a,** a reduction mechanism **65b,** and/or a drive pulley (not illustrated) that engages with the guide wire **64.** The drive pulley is rotated in both (normal and reverse) directions by the motor **65a** preferably via the reduction mechanism **65b,** thereby making the guide wire **63** reciprocate. The reciprocation of the guide wire **63** drives (or assists the displacement of) the slide door **20** between the closed position CP and the open position OPP.

[0041] FIG. **11** shows a control system of the motor **65a,** in which reference character **U** denotes a controller (control unit) using a micro computer. One or more signals of the pressure sensitive switch **50** and/or other various switches **71** through **75** are inputted to the controller **U.** The respective switches **71** through **75** are manually operated for commanding the opening and closing of the slide door **20.** The switch **71** is provided at a driver seat, the slide-door switch **72** is provided at the inner face of the slide door **20,** and the remote control switch **73** is portable by the passenger. The inner-door switch **74** is provided at the inner side face of the side door **20** and attached to an inner door handle that is operated by the passenger seated in the rear seat **11** by adding an operational force. Likewise, the outer-door switch **75** is provided at the outer side face of the side door **20** and attached to an outer door handle that is operated e.g. by the passenger who wants to seat in the rear seat **11** by adding an operational force. Part of the above-described switches may be used, not all of them.

[0042] When the controller **U** receives a command signal of opening from any one of the switches **71** through **75** while the slide door **20** is in the closed position CP, it executes a control of driving the motor **65a** so as to open the slide door **20.** When the pressure sensitive switch **50** turns on while the slide door **20** moves from the closed position CP towards or to the open position OP, the driving of the slide door **20** toward the open position is made stop. Herein, the slide door **20** preferably may be controlled so as to go back slightly toward the closed position CP after this driving stop.

[0043] The control content of the controller **U** is shown by a flowchart in FIG. **12.** Hereinafter, reference character **Q** denotes each step in the flowchart. And, the control sequence starts with a premise that the vehicle speed is zero (vehicle stop) for safety. First, in step **Q** it is determined whether the slide door **20** is currently in the closed position CP or not. When the determination in the step **Q** is YES, it is determined in step **Q2** whether or not the command signal of opening is received from at least any one of the switches **71** through **75.** When the determination in the step **Q2** is YES, the side door **20** is driven toward the open position OPP (driving of the motor **65a)** in step **Q3.** Then, it is determined in step **Q4** whether or not the pressure sensitive switch **50** turns on. When the determination in the step **Q4** is YES, the driving of the side door **20** toward the open position is forced to stop automatically. Herein, the slide door **20** preferably may be controlled so as to go back slightly toward the closed position CP after the driving stop as described above. When the determination in the step **Q1** is NO and the determination in the step **Q2** is NO, or when the determination in the step **Q4** is NO, the control sequence returns without having going through step **Q5** (the slide door **20** is driven to the open position OPP).

[0044] Accordingly, a slide door **20** is provided to be movable between a closed position to cover a side opening **10** formed at a vehicle-body side face and an open position. The slide door **20** is configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door moves from the closed position CP to the open position OPP. There is provided a detection sensor **50** to detect a foreign matter in coming into a gap **S** from a vehicle-compartment inside. A drive of the slide door **20** is stopped in case the detection sensor **50** detects the foreign matter in coming into the gap **S** when the slide door **20** moves toward the open position OPP. Thereby, any foreign matter can be prevented from being pinched in the gap formed between the slide door and the rear edge portion of the side opening.

EMBODIMENT 2

[0045] FIGS. **13** and **14** show a second embodiment

of the present invention. Herein, the similar or same structure elements as those in the above-described first embodiment are denoted by the same reference characters, and duplicated descriptions on those are omitted here. In the present embodiment, the pressure sensitive switch **50** is to be attached to the rear-edge side face portion **3b** of the open edge portion **15.** That is, as shown in FIG. **14,** the holding bracket **40** is to be fixed to the rear-edge side face portion **3b,** and the casing **51** of the pressure sensitive switch **50** is to be fixed to the holding bracket **40.** The contact **52** of the pressure sensitive switch **50** faces outward. Herein the contact **52** (its tip portion) is sealed from the outside with a seal member **56.**

[0046] Meanwhile, a pressing portion **30c** is formed at the cover member **30** so as to project from a portion of the cover member **30** that is located near its rotational center and at a level that substantially corresponds to the disposition level of the holding bracket **40** (pressure sensitive switch **50).** The pressing portion **30c** comes to contact or approach to the contact **52** of the pressure sensitive switch **50** when the cover member **30** is in the operative position. Accordingly, when the rearward outer force that is the specified (predetermined or predeterminable) value or greater acts on the cover member **30** in the operative position OP that is biased with the coil spring **43** as the preferred biasing means, the cover member **30** is rotated or pivoted rearward slightly to push the pressure sensitive switch **50,** so that the pressure sensitive switch **50** turns on (operates). Herein, the biasing force of the coil spring **43** is relatively small, so the pressure sensitive switch **50** does not turn on unless the rearward outer force that is the specified value or greater acts on the cover member **30.**

[0047] In FIG. **14,** which shows an example of panel structure that forms the open edge portion **15** (rear-edge side face portion **3b),** reference character **80** denotes an outer panel, reference character **81** denotes an inner panel, and reference character **82** denotes at least one reinforcement. At the outer panel **80** and/or the at least one reinforcement **82** are formed attachment holes **83** for the pressure sensitive switch **50.** One or more codes **55** of the pressure sensitive switch **50** are disposed between the inner panel **81** and the reinforcement **82.**

EMBODIMENT 3

[0048] FIGS. **15** through **17** show a third embodiment of the present invention. Herein, the similar or same structure elements as those in the above-described first embodiment are denoted by the same reference characters, and duplicated descriptions on those are omitted here. In the present, a stopper portion **40b** is formed at the holding bracket **40** so as to project substantially downward, which prevents the cover member **30** from rotating or pivoting beyond a specified (predetermined or predeterminable) range. The lower holding bracket **40** has also this stopper portion **40b.** Thus, the prevention of the cover member **30** beyond the specified range can be achieved surely by the both stopper portions **40b.**

[0049] The present invention should not be limited to the above-described embodiments, and any other modifications may be applied within the scope of a sprit of the present invention. For example, the cover member **30** may be comprised of two or more parts, particularly substantially vertically-split parts. In this case, the gap **S** may be preferably covered in a properly wide range in the vehicle width direction, providing an easy adjustment for change in a vertical-direction contour of the rear-edge front face portion **3a.** Any type of detection sensor may be used, not limited to the above-described pressure sensitive switch **50.** In case of using photo sensor, detection ray is emitted toward the gap **S.** And the sensor is configured such that the detection ray is directly received, or its reflected ray is received. Herein, if part of the ray is not received, it may be determined that any foreign matter comes into the gap **S.**

Claims

1. A pinch prevention structure of a slide door **(20),** comprising:

a slide door **(20)** provided to be movable between a closed position (CP) in which the slide door **(20)** at least partly covers a side opening **(10)** formed at a vehicle-body side face and an open position (OPP) in which the slide door **(20)** substantially opens the side opening **(10),** the slide door **(20)** being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door **(20)** moves from the closed position (CP) to the open position (OPP);
a drive device **(65)** operative to drive the slide door **(20)** so as to move between the closed position (CP) and the open position (OP);
a drive control device **(U)** operative to control the drive device **(65);** and
a detection sensor **(50)** operative to detect a foreign matter in coming into a gap **(S)** from a vehicle-compartment inside, which is formed between an inner side face of the slide door **(20)** in the open position (OPP) and a rear edge portion **(3)** of the side opening **(10)** when the slide door **(20)** is moved from the closed position (CP) to the open position (OPP),

wherein the drive control device **(U)** is configured so that a drive of the slide door **(20)** by the drive device **(65)** is stopped in case the detection sensor **(50)** detects the foreign matter in coming into the gap **(S)** when the drive device **(65)** drives the slide door **(20)** in the closed position (CP) toward the open position (OPP).

2. The pinch prevention structure of a slide door **(20)** of claim 1, wherein the rear edge portion **(3)** of the side opening **(10)** includes a rear-edge front face portion **(3a)** that faces substantially forward and a rear-edge side face portion **(3b)** that extends substantially forward from an inside end of the rear-edge front face portion **(3a),** the rear-edge front face portion **(3a)** and the rear-edge side face portion **(3b)** forming an open edge portion **(15)** that is recessed toward the vehicle inside, at the open edge portion **(15)** is provided a cover member **(30)** that is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover at least part of said gap **(S)** formed when the slide door **(20)** is moved from the closed position (CP) toward the open position (OPP), and said detection sensor **(50)** is configured to detect the foreign matter in contacting the cover member **(30)** in an operative position from the front.

3. The pinch prevention structure of a slide door **(20)** of claim 2, wherein said cover member **(30)** is comprised of a plate member that extends substantially vertically and configured to operate so as to at least partly cover the part of the gap **(S)** in connection with the slide door **(20)** moving from the closed position (CP) to the open position (OPP).

4. The pinch prevention structure of a slide door **(20)** of claim 2 or 3, wherein said cover member **(30)** is provided so as to rotate around a vertically-extending axis **(35)** between the operative position (OP) in which the cover member **(30)** extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction, a biasing means **(43)** for biasing the cover member **(30)** toward the operative position (OP) is provided, and said detection sensor **(50)** is configured to detect the foreign matter in response to a rearward move of an outside end portion of the cover member **(30)** in the operative position (OP) receives an outer force from the front that is greater than a biasing force of the biasing means **(43).**

5. The pinch prevention structure of a slide door **(20)** of any one of the preceding claims 2 through 4, wherein said cover member **(30),** which is comprised of a plate member that extends substantially vertically, is supported by a vehicle body **(1)** at an inside end portion thereof that is held rotatably around a substantially vertically-extending axis **(35)** so that the cover member **(30)** moves between the operative position (OP) and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction along the rear-edge side face portion **(3b)** of the open edge portion **(15),** a biasing means **(43)** for biasing the cover member **(30)** toward the operative position is provided, and the cover member **(30)** is configured such that the cover member **(30)** is rotated toward the operative position (OP) by the biasing means **(43)** when the slide door **(20)** is moved toward the open position (OPP) from the closed position (CP), while the cover member **(30)** is coupled to, preferably is pushed by, the slide door **(20)** so as to come to the store position (SP) when the slide door **(20)** is moved toward the closed position (CP) from the open position (OPP).

6. The pinch prevention structure of a slide door **(20)** of any one of the preceding claims 2 through 5, wherein said cover member **(30)** is configured such that an outside end portion thereof in the operative position has a contour that corresponds to a contour of the inner side face of the slide door **(20).**

7. The pinch prevention structure of a slide door **(20)** of any one of the preceding claims 2 through 6, wherein an armrest **(21)** is formed at the inner side face of the slide door **(20)** so as to project, and said cover member **(30)** is configured to cover the gap **(S)** at least at a level of or near an upper face of the armrest **(21).**

8. The pinch prevention structure of a slide door **(20)** of any one of the preceding claims 2 through 6, wherein an armrest (**21**) is formed at the inner side face of the slide door **(20)** so as to project, and an outside end portion of the cover member **(30)** in the operative position has a notch **(30a)** with a contour that corresponds to a contour of the armrest **(21).**

9. A cover member **(30)** for a pinch preventing structure of a slide door **(20)** provided to be movable between a closed position (CP) in which the slide door **(20)** at least partly covers a side opening **(10)** formed at a vehicle-body side face and an open position (OPP) in which the slide door **(20)** substantially opens the side opening **(10),** the slide door **(20)** being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door **(20)** moves from the closed position (CP) to the open position (OPP), wherein the cover member **(30)** is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover at least part of a gap **(S)** formed when the slide door **(20)** is moved from the closed position (CP) toward the open position (OPP).

10. The cover member **(30)** of claim 9, wherein said cover member **(30)** is comprised of a plate member that extends substantially vertically and configured to op-

erate so as to at least partly cover the part of the gap **(S)** in connection with the slide door **(20)** moving from the closed position (CP) to the open position (OPP).

11. The cover member **(30)** of claim 9 or 10, wherein said cover member **(30)** is provided so as to rotate around a vertically-extending axis **(35)** between the operative position (OP) in which the cover member **(30)** extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction, a biasing means **(43)** for biasing the cover member **(30)** toward the operative position (OP) is provided, and a detection sensor **(50)** is configured to detect the foreign matter in response to a rearward move of an outside end portion of the cover member **(30)** in the operative position (OP) receives an outer force from the front that is greater than a biasing force of the biasing means **(43).**

12. The cover member **(30)** of any one of the preceding claims 9 through 11, wherein said cover member **(30),** which is comprised of a plate member that extends substantially vertically, is to be supported by a vehicle body **(1)** at an inside end portion thereof that is holdable rotatably around a substantially vertically-extending axis **(35)** so that the cover member **(30)** moves between the operative position (OP) and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction along the rear-edge side face portion **(3b)** of the open edge portion **(15),** a biasing means **(43)** for biasing the cover member **(30)** toward the operative position is provided, and the cover member **(30)** is configured such that the cover member **(30)** is rotated toward the operative position (OP) by the biasing means **(43)** when the slide door **(20)** is moved toward the open position (OPP) from the closed position (CP), while the cover member **(30)** is coupled to, preferably is pushed by, the slide door **(20)** so as to come to the store position (SP) when the slide door **(20)** is moved toward the closed position (CP) from the open position (OPP).

13. A pinch prevention method for a slide door **(20)** movable between a closed position (CP) in which the slide door **(20)** at least partly covers a side opening **(10)** formed at a vehicle-body side face and an open position (OPP) in which the slide door **(20)** substantially opens the side opening **(10),** the slide door **(20)** being configured to move outward and subsequently slide rearward along a rear vehicle-body outer face when the slide door **(20)** moves from the closed position (CP) to the open position (OPP), the method comprising the following steps
driving the slide door **(20)** so as to move between the closed position (CP) and the open position (OP);
detecting a foreign matter in coming into a gap **(S)** from a vehicle-compartment inside, which is formed between an inner side face of the slide door **(20)** in the open position (OPP) and a rear edge portion **(3)** of the side opening **(10)** when the slide door **(20)** is moved from the closed position (CP) to the open position (OPP),
wherein a drive of the slide door **(20)** is stopped in case the foreign matter is detected in coming into the gap **(S)** when the slide door **(20)** is driven in the closed position (CP) toward the open position (OPP).

14. The pinch prevention method of claim 13, wherein in the step of detecting it is detected whether the foreign matter contacts substantially from the front a cover member **(30)** that is operative to extend at an angle different from 0° or 180° with respect to a vehicle longitudinal direction, preferably substantially in a vehicle width direction so as to cover at least part of a gap **(S)** formed when the slide door **(20)** is moved from the closed position (CP) toward the open position (OPP), the cover member **(30).**

15. The pinch prevention method of claim 13 or 14, wherein said cover member **(30)** is provided so as to rotate around a vertically-extending axis **(35)** between the operative position (OP) in which the cover member **(30)** extends at an angle different from 0° or 180° with respect to the vehicle longitudinal direction, preferably substantially in the vehicle width direction and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction, a biasing means **(43)** for biasing the cover member **(30)** toward the operative position (OP) is provided, and in said detecting step of the foreign matter is detected in response to a rearward move of an outside end portion of the cover member **(30)** in the operative position (OP) receives an outer force from the front that is greater than a biasing force of the biasing means **(43),** and/or
wherein said cover member **(30),** which is comprised of a plate member that extends substantially vertically, is supported by a vehicle body **(1)** at an inside end portion thereof that is held rotatably around a substantially vertically-extending axis **(35)** so that the cover member **(30)** moves between the operative position (OP) and a store position (SP) in which the cover member **(30)** extends substantially in a vehicle longitudinal direction along the rear-edge side face portion **(3b)** of the open edge portion **(15),** a biasing means **(43)** for biasing the cover member **(30)** toward the operative position is provided, and the cover member **(30)** is configured such that the cover member **(30)** is rotated toward the operative position (OP) by the biasing means **(43)** when the slide door **(20)** is moved toward the open position (OPP) from the closed position (CP), while the cover member **(30)**

is coupled to, preferably is pushed by, the slide door **(20)** so as to come to the store position (SP) when the slide door **(20)** is moved toward the closed position (CP) from the open position (OPP).

FIG. 1

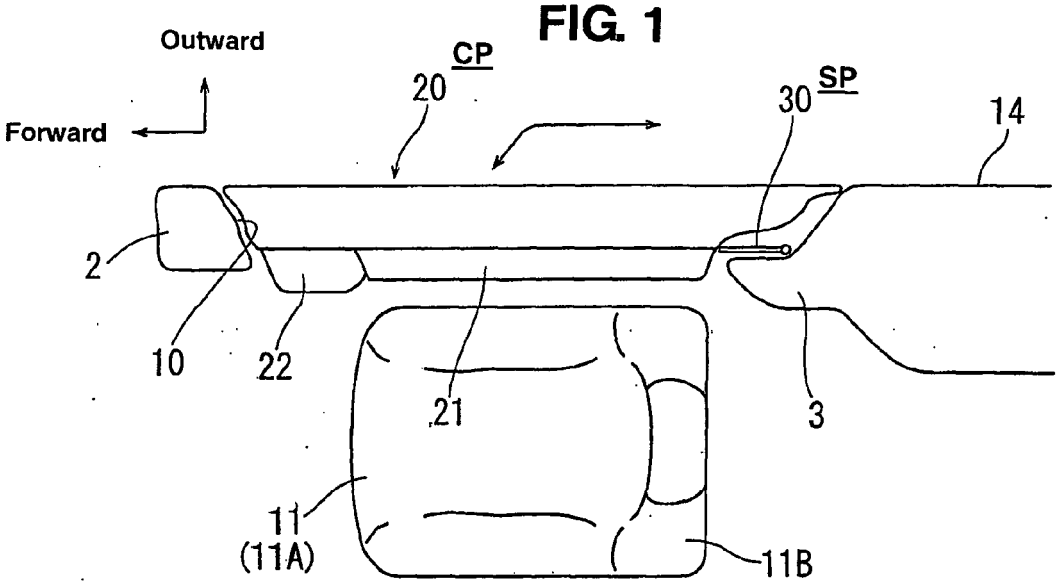

Outward
Forward
CP
20
30
SP
14
2
10
22
21
3
11
(11A)
11B

FIG. 2

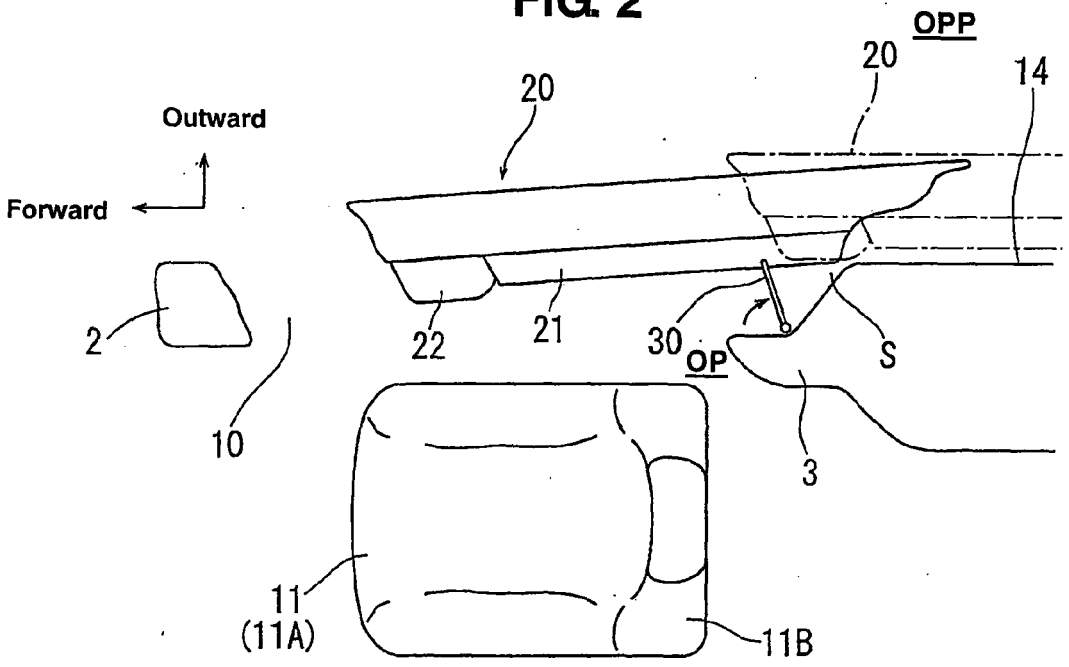

OPP
20
20
14
Outward
Forward
2
22
21
30
OP
S
10
3
11
(11A)
11B

FIG. 3

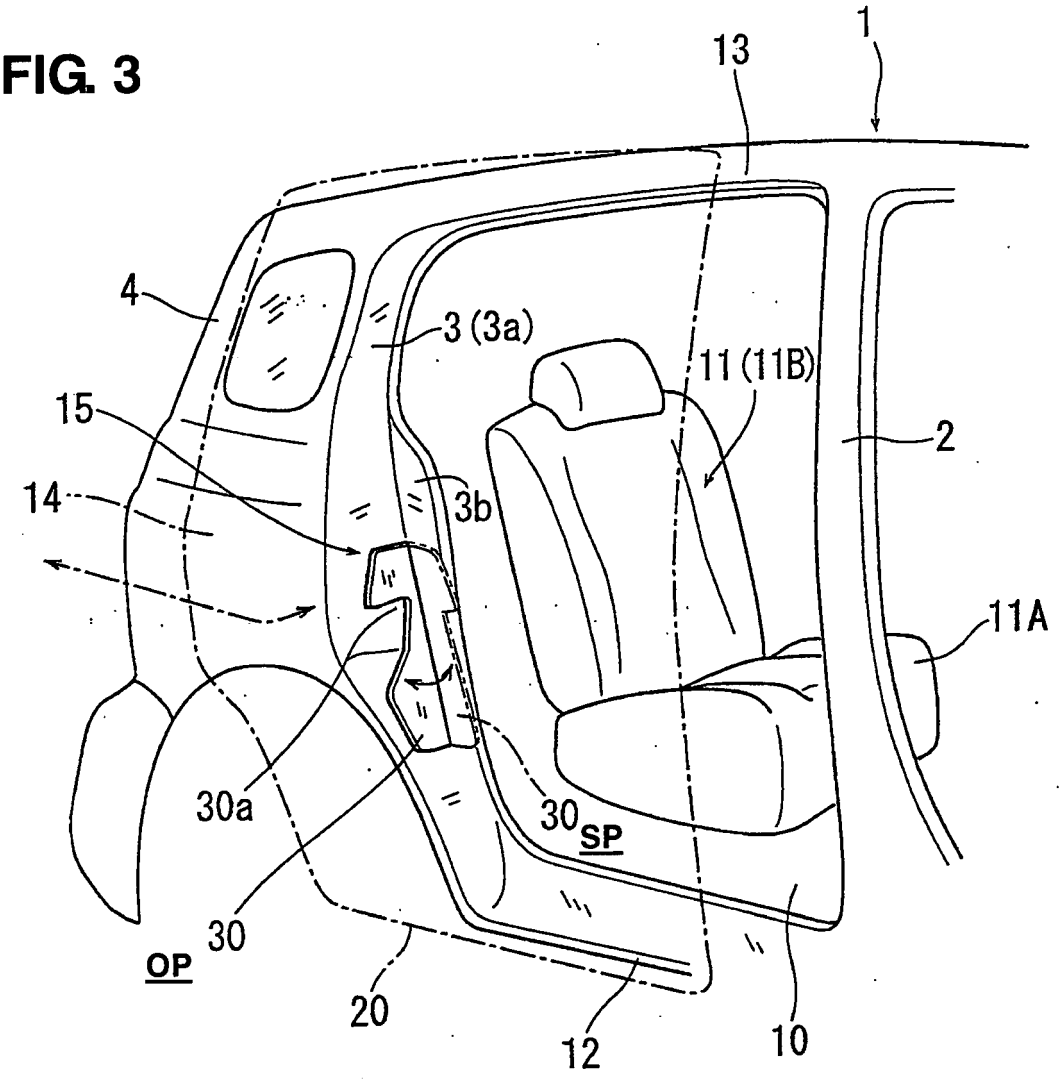


FIG. 4

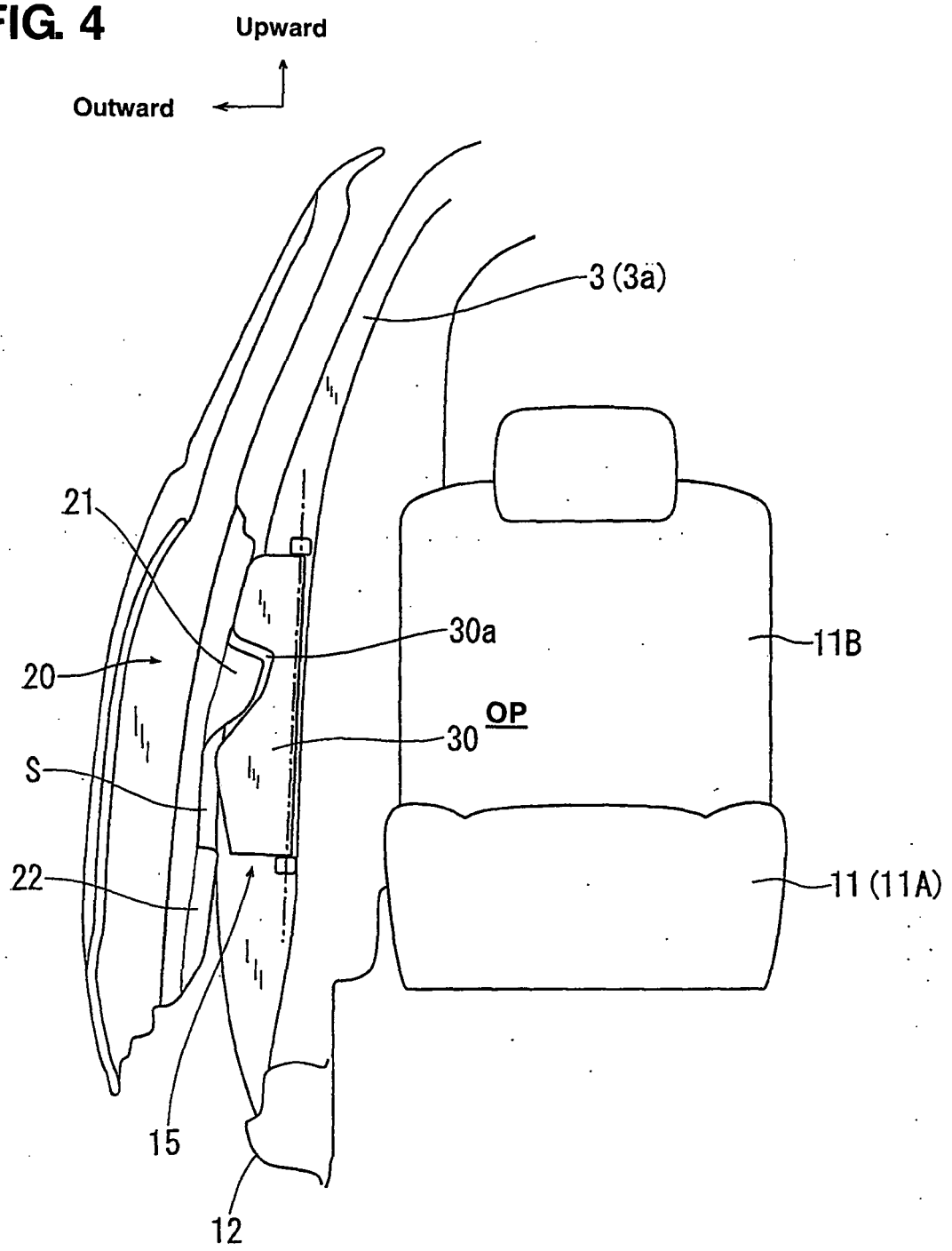


FIG. 5

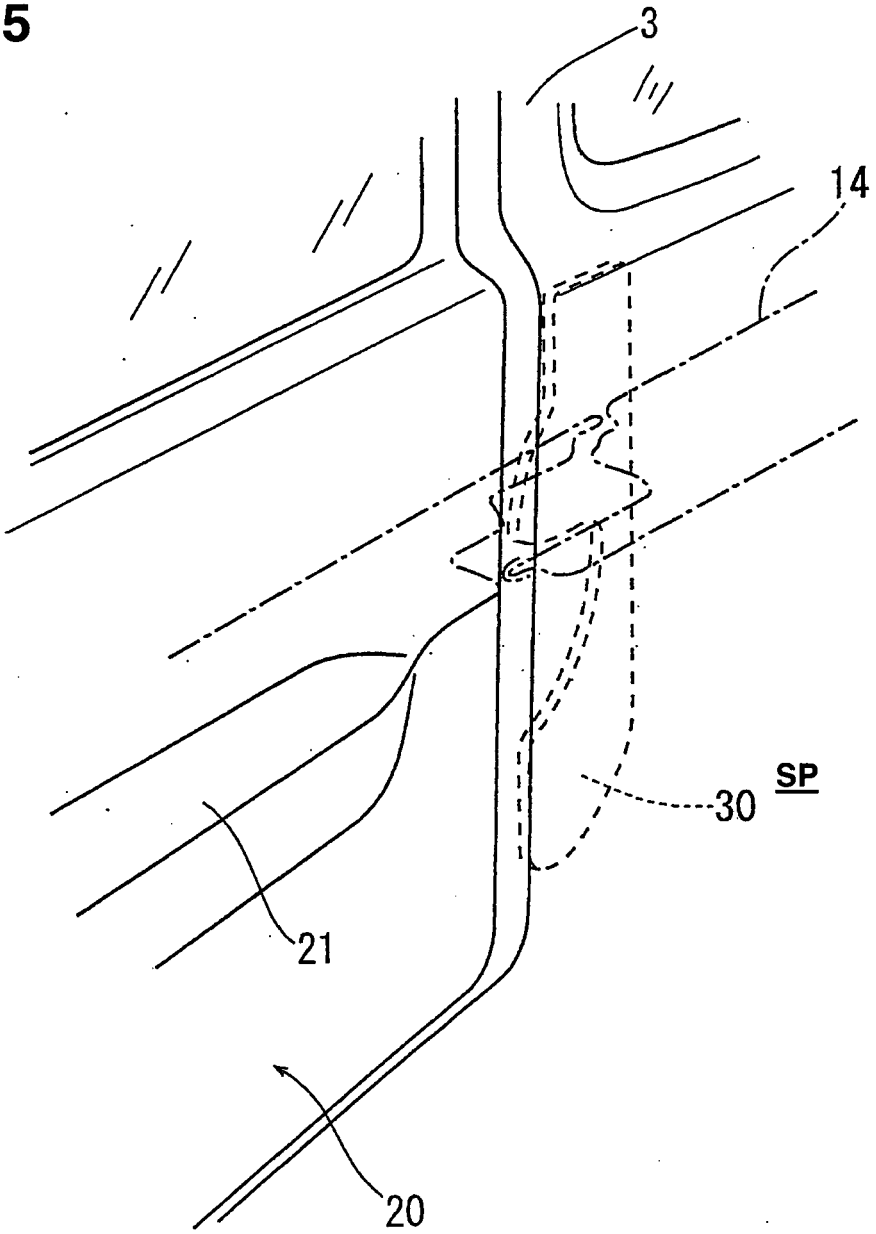


FIG. 6

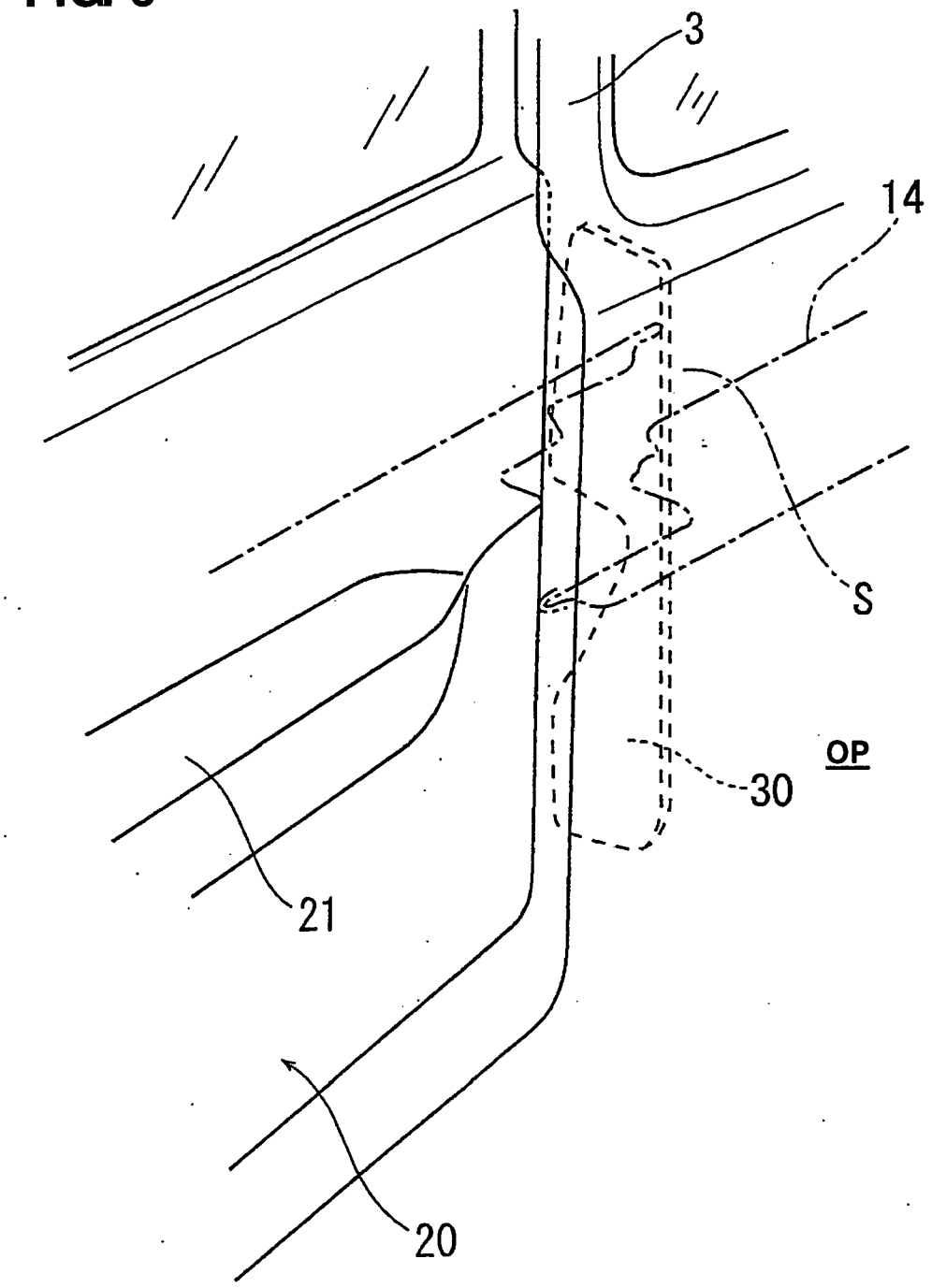


FIG. 7

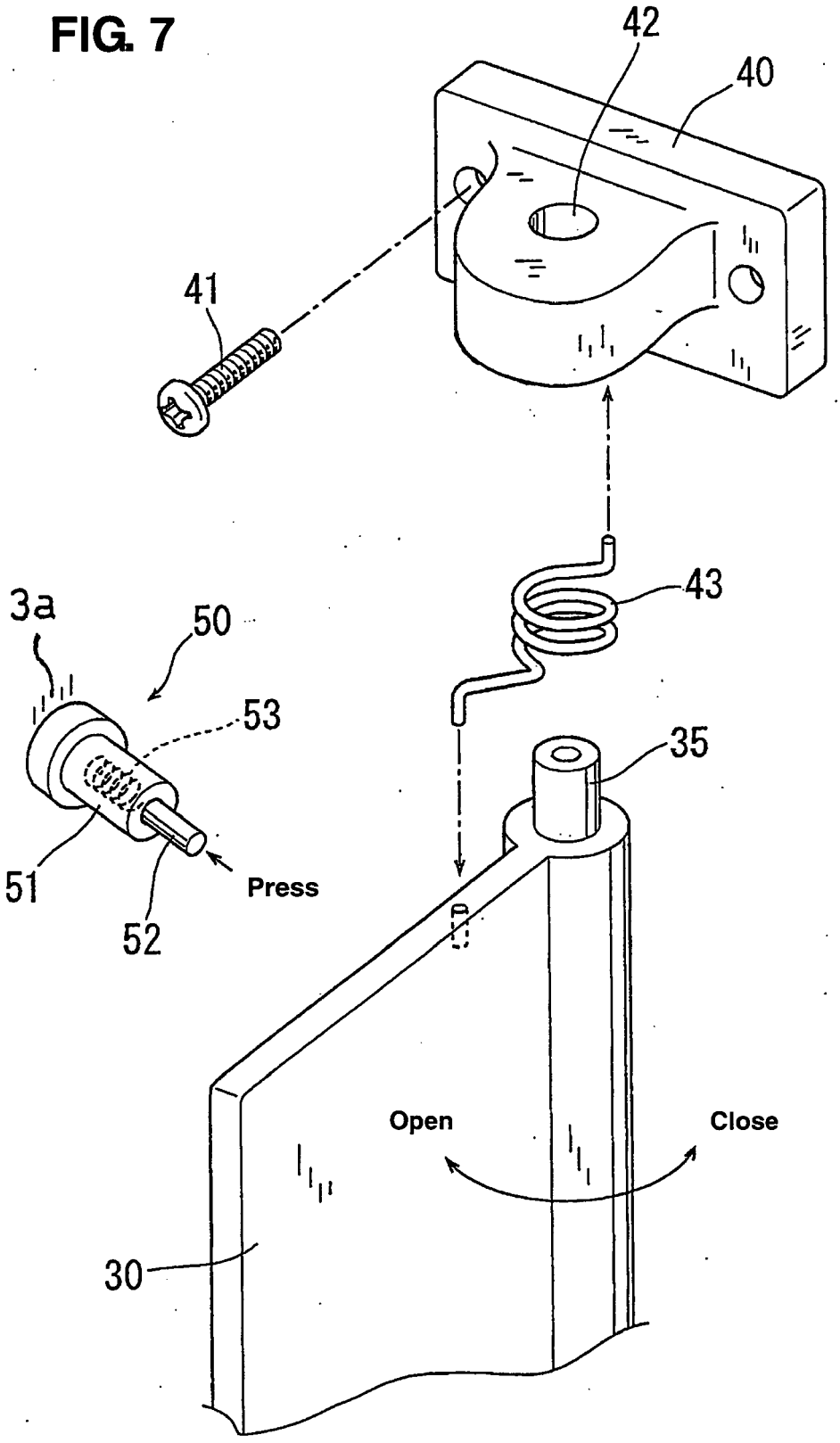


FIG. 8

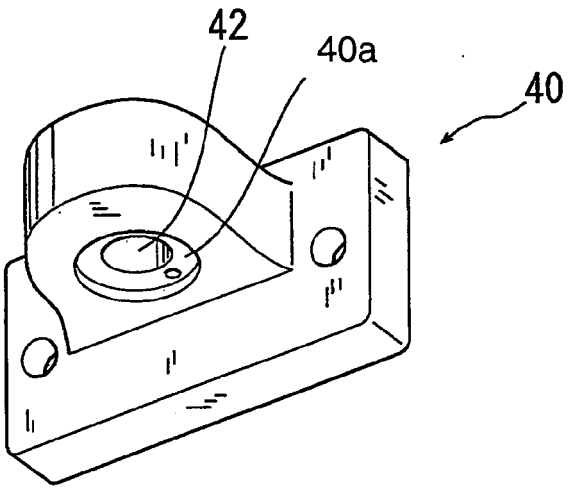
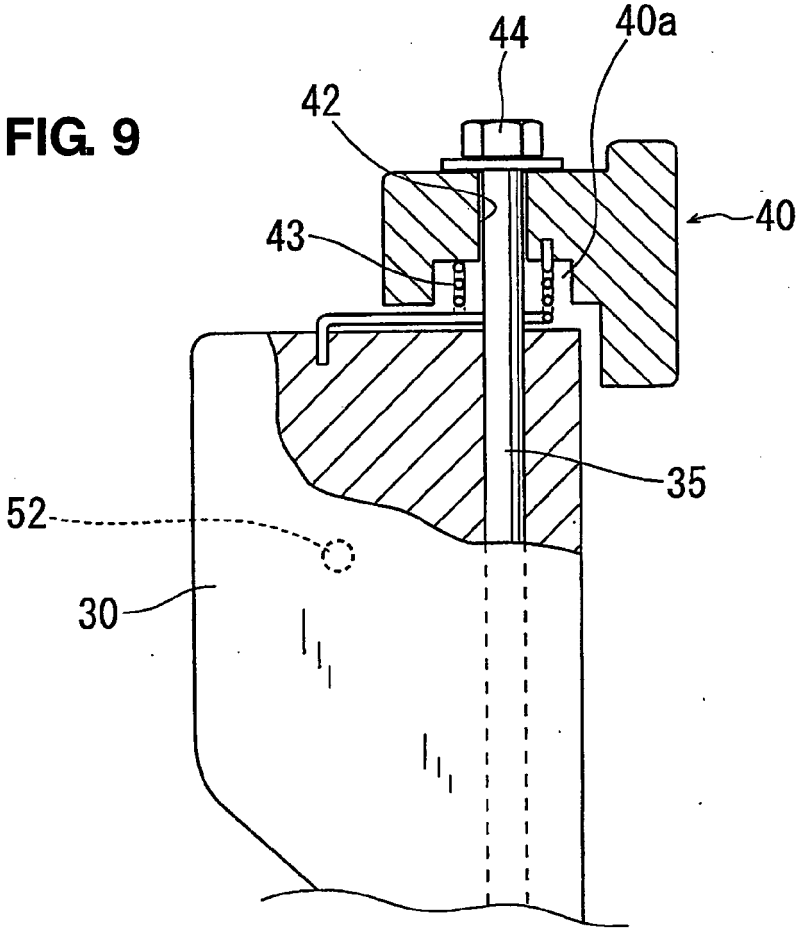


FIG. 9



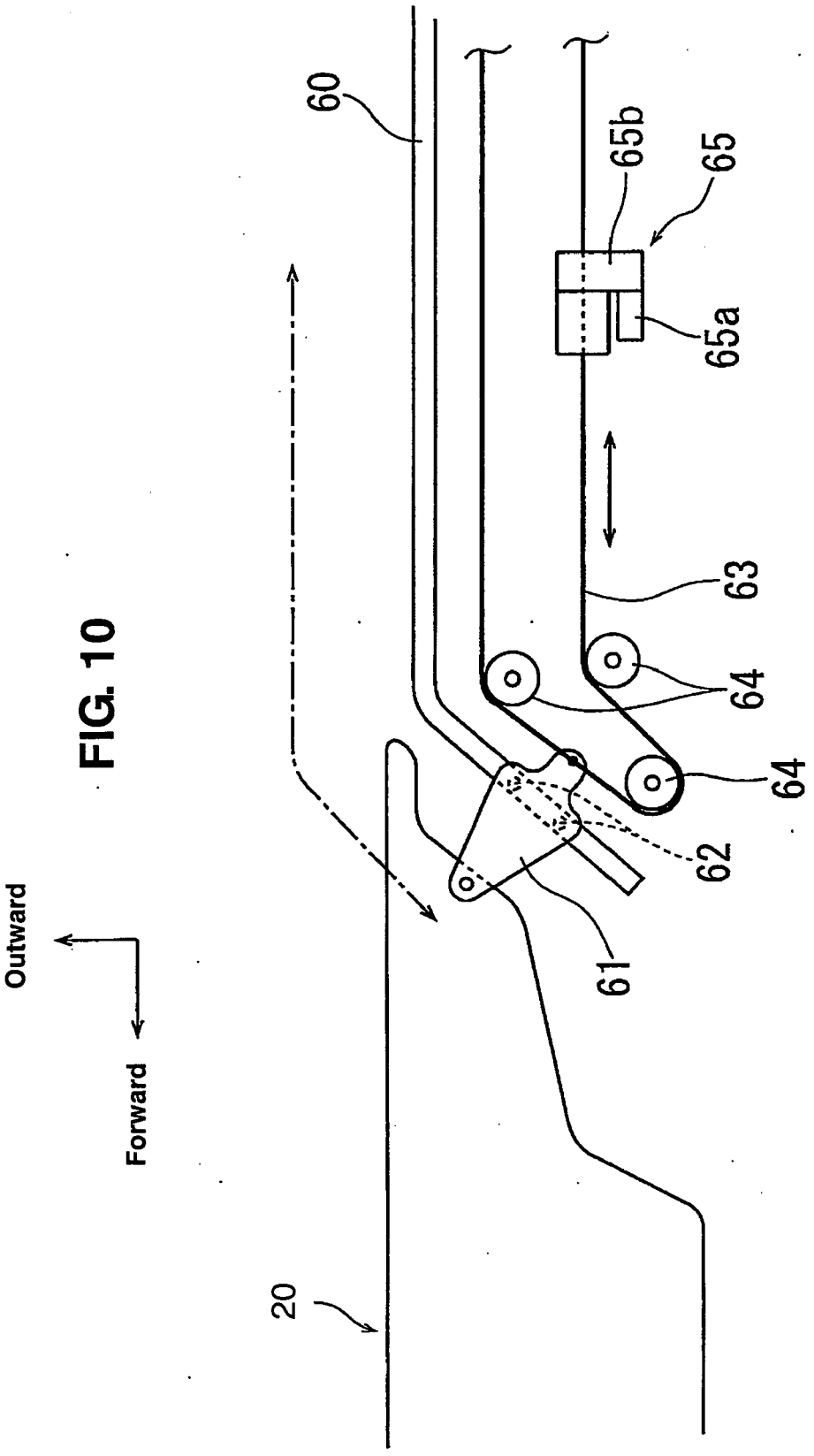


FIG. 10

FIG. 11

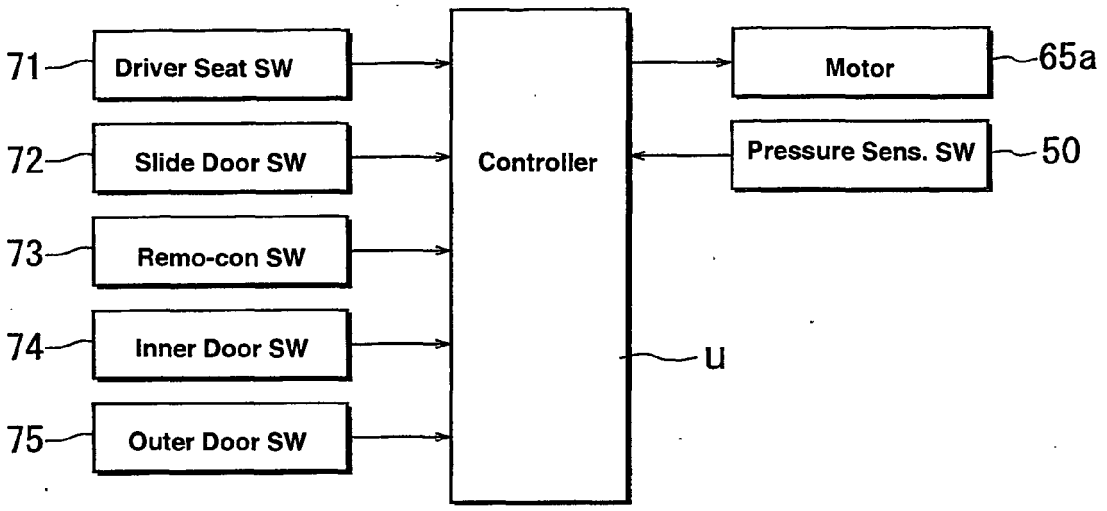

71
Driver Seat SW
72
Slide Door SW
73
Remo-con SW
74
Inner Door SW
75
Outer Door SW
Controller
u
Motor
65a
Pressure Sens. SW
50

FIG. 12

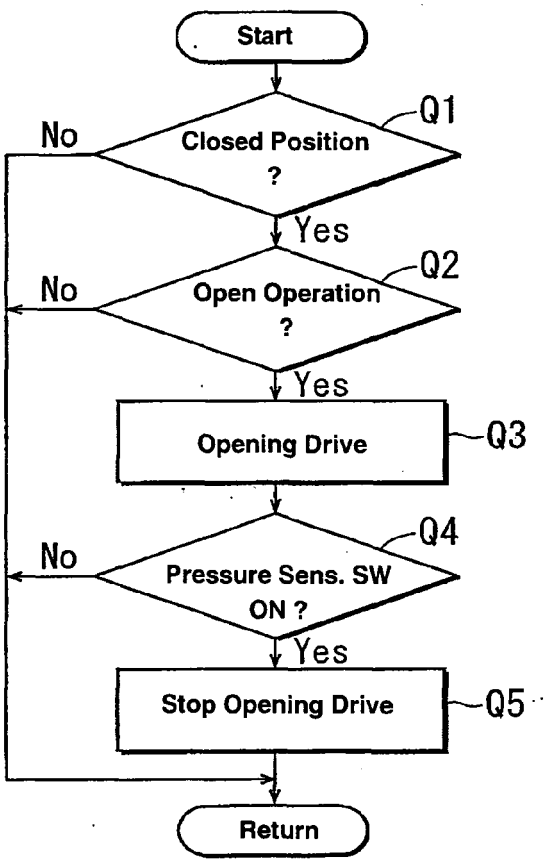
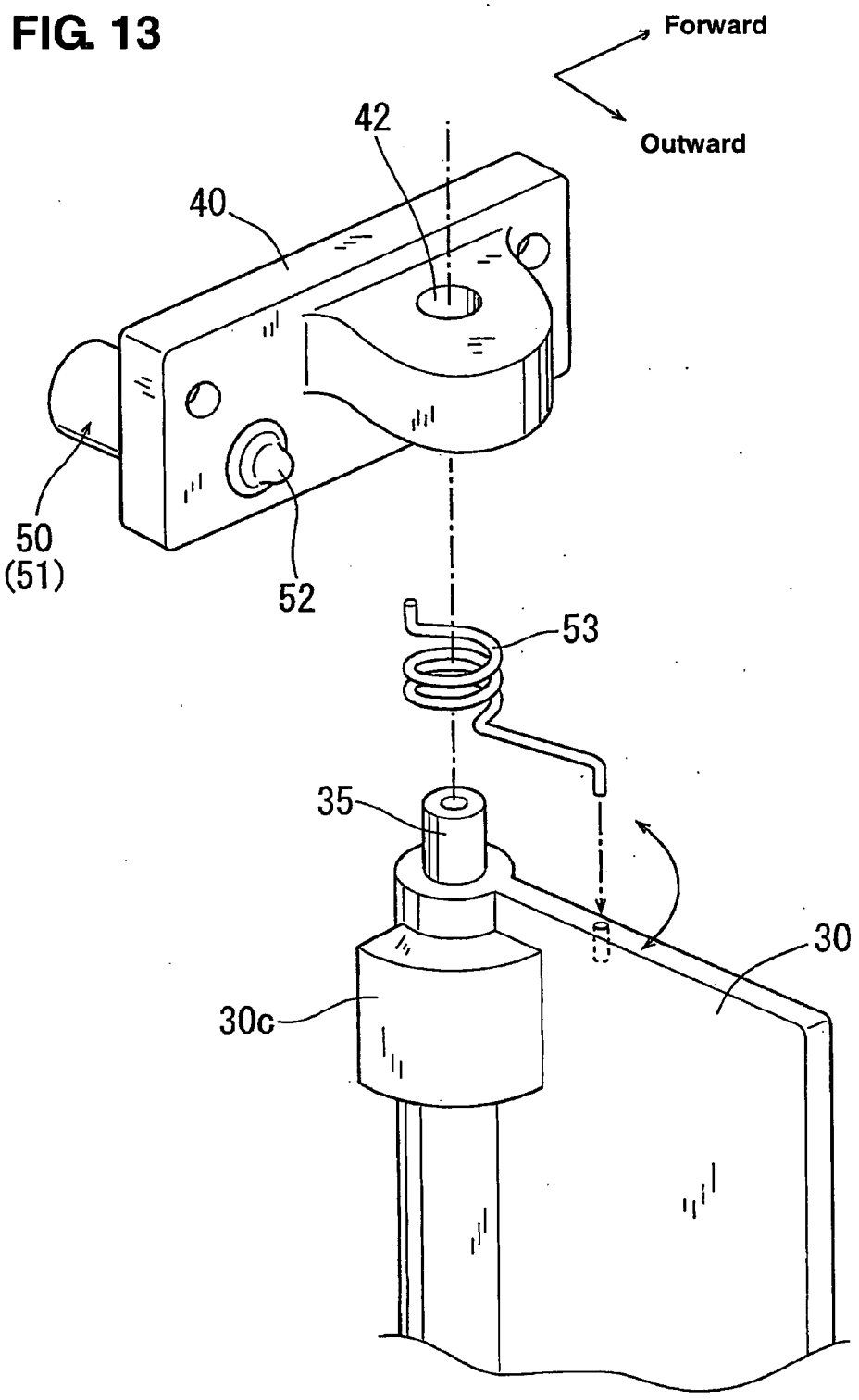

Start
Q1
Closed Position ?
No
Yes
Q2
Open Operation ?
No
Yes
Opening Drive
Q3
Q4
Pressure Sens. SW ON ?
No
Yes
Stop Opening Drive
Q5
Return

FIG. 13



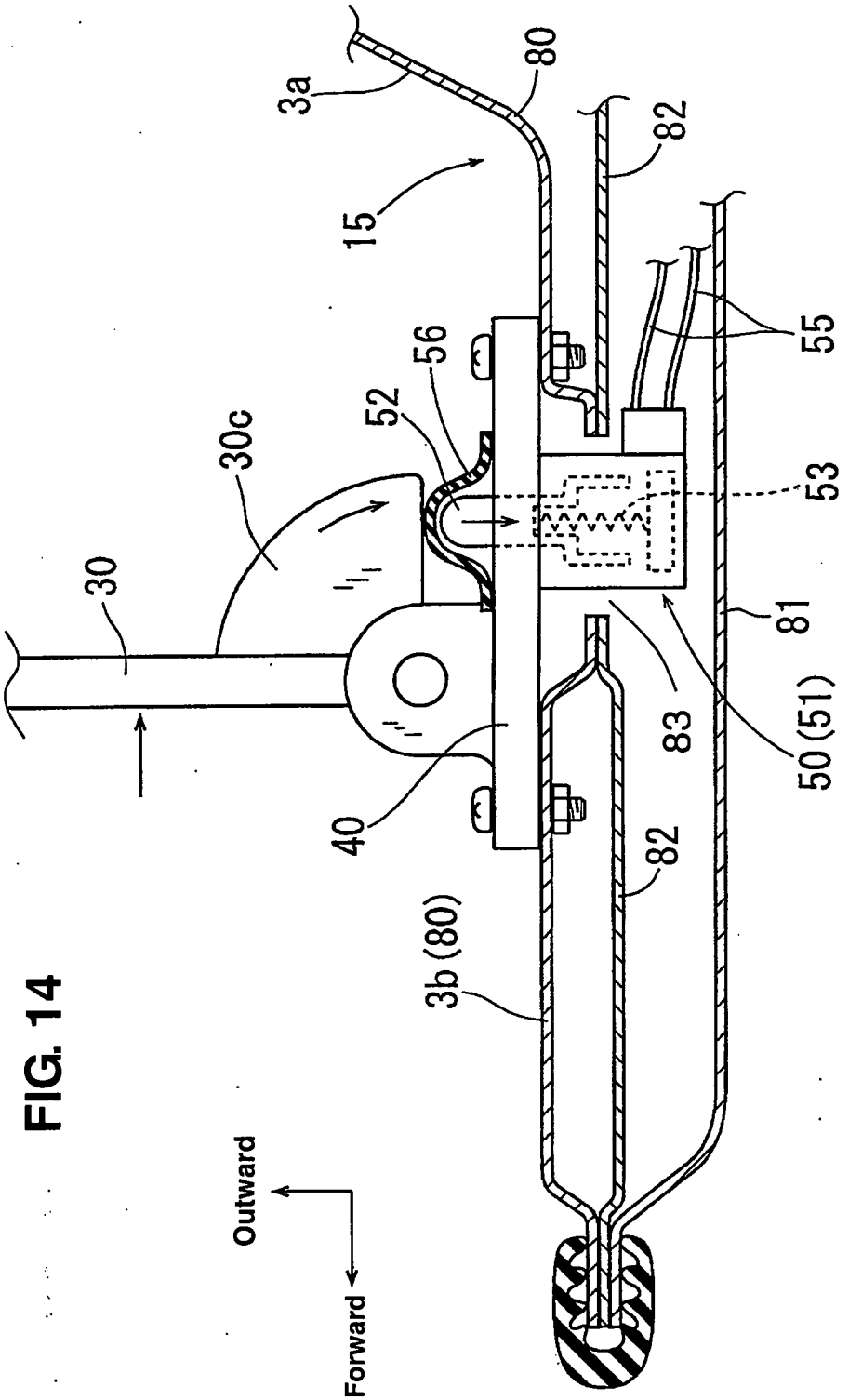

3a
80
82
15
55
56
52
53
30c
30
81
83
50 (51)
40
82
3b (80)
Outward
Forward

FIG. 14

FIG. 15

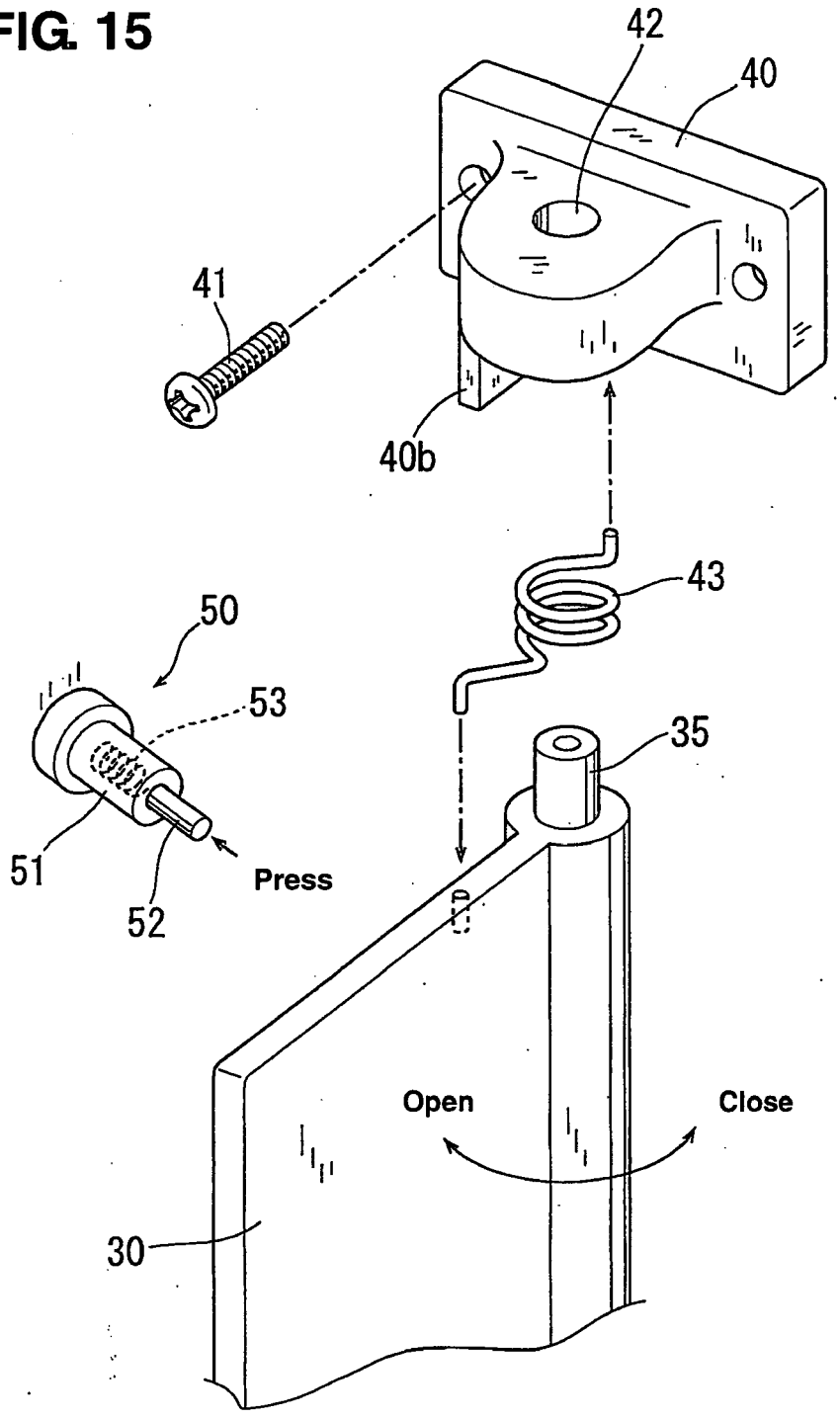


FIG. 16

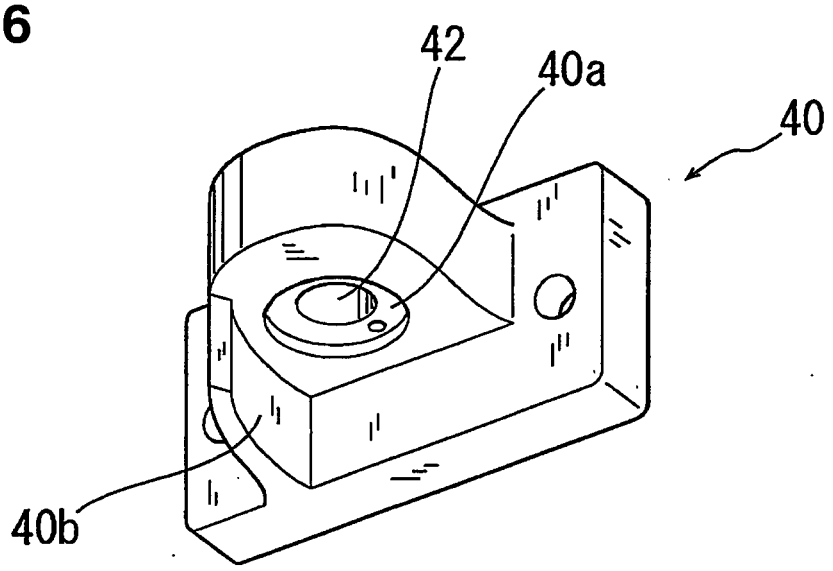
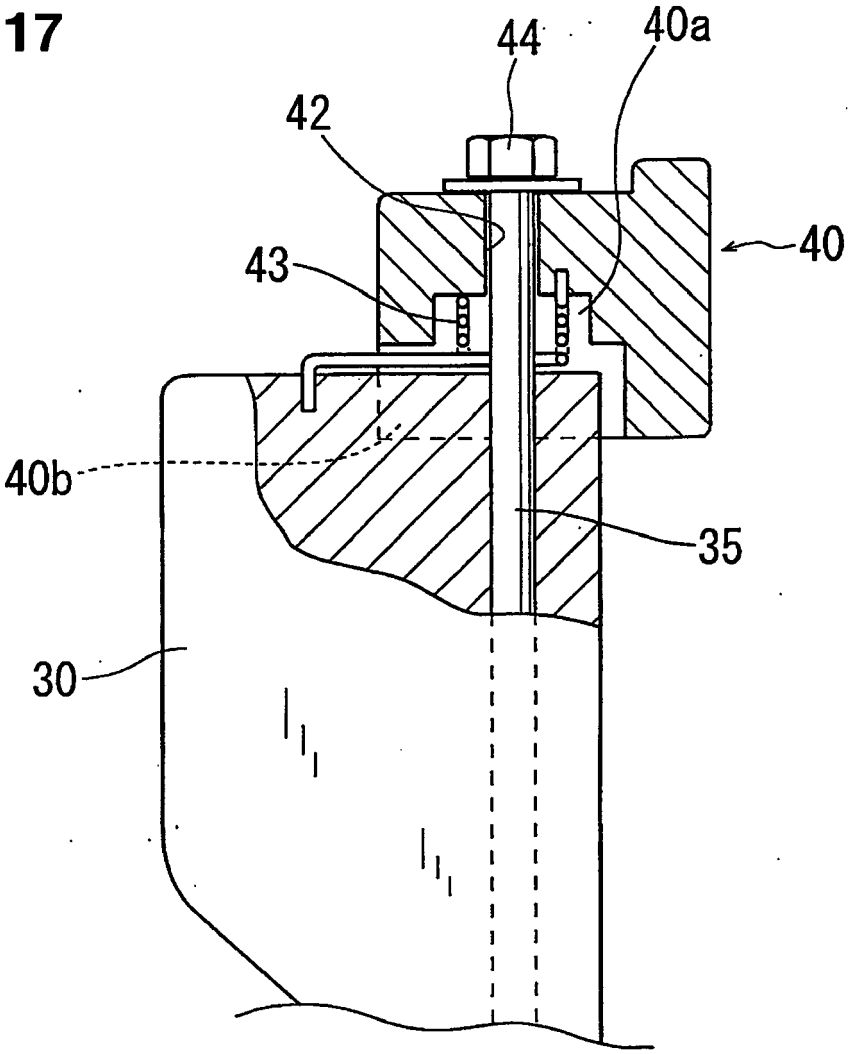


FIG. 17



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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 0051

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,X	JP 2007 056522 A (TOYOTA MOTOR CORP) 8 March 2007 (2007-03-08) * paragraph [0035] - paragraph [0036] * * figure 3b * -----	1,13	INV. E05F15/00 E05F15/14 B60J5/04
X	DE 198 10 077 A1 (ASMO CO LTD [JP]) 17 September 1998 (1998-09-17) * column 2, line 22 - line 44 * * column 3, line 14 - line 37 * * figures 1,2 * -----	1,13	
A	JP 09 077440 A (OTIS ELEVATOR CO) 25 March 1997 (1997-03-25) * abstract * -----	2-4, 9-11,14, 15	

TECHNICAL FIELDS SEARCHED (IPC)

E05F
E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 October 2008	Van Kessel, Jeroen

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 01 0051

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